Durability Testing of CBRN Powered Air-Purifying Respirators (PAPR)

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Durability Testing Includes: Environmental, Transportation and Rough Handling

- Purpose/Goal
- Assumptions
- Types of Tests
- Rationale for the Test

Purpose/Goal

Purpose of Tests: Perform environmental storage, transportation shock and drop tests on the CBRN PAPR to qualify durability and to detect any initial life cycle failures that may occur from typical use.

Goal: To ensure CBRN PAPR provides adequate respiratory protection after being subjected to normal environmental storage, transportation and rough handling conditions by the user.

Assumptions

- Tests represent conditions induced by the user that a CBRN PAPR may experience from the point of issue.
- CBRN PAPR will be subjected to the test conditions in the "Ready-to-Use" configuration as recommended by the manufacturer. (e.g., loose, in carrier or storage container) Filter unit will not be mounted on the PAPR unless specified by the manufacturer.
- Maintenance and inspection shall be performed IAW applicable Department of Labor, OSHA Title 29 CFR 1910.134(h).
- Non-industrial use scenario – for CBRN emergency use only.

Assumptions (Continued)

- Test conditions tailored to realistic U.S. meteorological weather conditions, U.S. roadway transportation conditions and typical first responder use rough handling conditions (i.e., not worst case).

- Tests not intended to represent entire life cycle but rather to identify potential initial life cycle failures.

- Mil-Spec 810-F used as principle guidance document.

Draft Test Protocol

A. Environmental Storage Conditions:

1. High Temperature
   - Mil-Std-810F, Method 501.4, Table 501.4-II, Hot-Dry Diurnal Cycle, Hot-Induced Conditions 35 ^{0}C (95 ^{0}F) to 71 ^{0}C (160^{0}F), 24 Hour Cycle, 3 Weeks

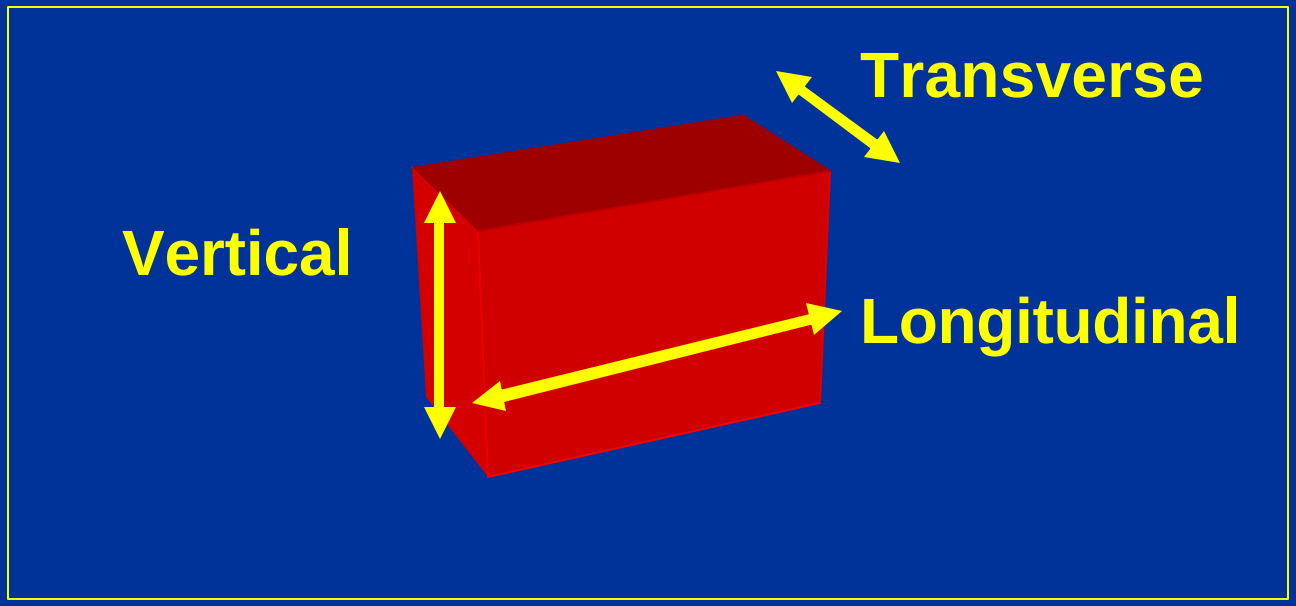
2. Low Temperature
   - Mil-Std-810F, Method 502.4, Basic Cold, Constant Temperature at –31 ^{0}C (-24 ^{0}F), 3 Days (72 Hours)

3. Humidity
   - Mil-Std-810E, Method 507.3, Figure 507.3-I (cycle 1), Natural Diurnal Humidity Cycle, 5 Days (“quick look”)
   (range 88^{0}F @ 88%RH – 105^{0}F @ 59%RH, 24 hr period)

B. Transportation:

Vibration

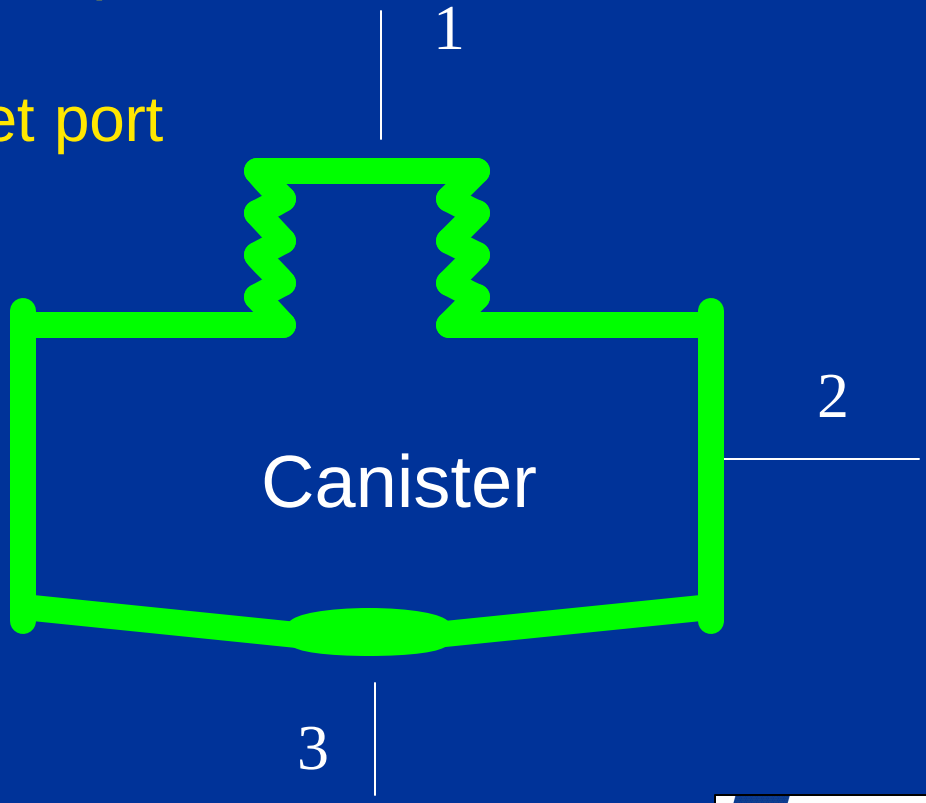
MIL-STD-810F, Method 514.5, Vibration, Annex A, Category 4, Over U.S. Highways, 60 minutes per 1,000 miles of road travel per axis, 3 Axis, 12 Hours per axis (36 hours total = 12,000 miles), Unrestrained



C. Drop Test: Filters Only

Drop 3 feet onto a concrete surface; Each canister dropped once; canisters dropped on each of the following axis:

(1) Major axis vertical, air outlet port.
(2) Major axis horizontal.
(3) Major axis vertical, air inlet port



Rationale for the Test

High Temperature: Simulates storage in trunk of vehicle; Induced conditions: solar loading/diurnal profile representative of southwest U.S. climates; Duration based on prior ARDEC (Formerly SBCCOM) experience with mask testing.

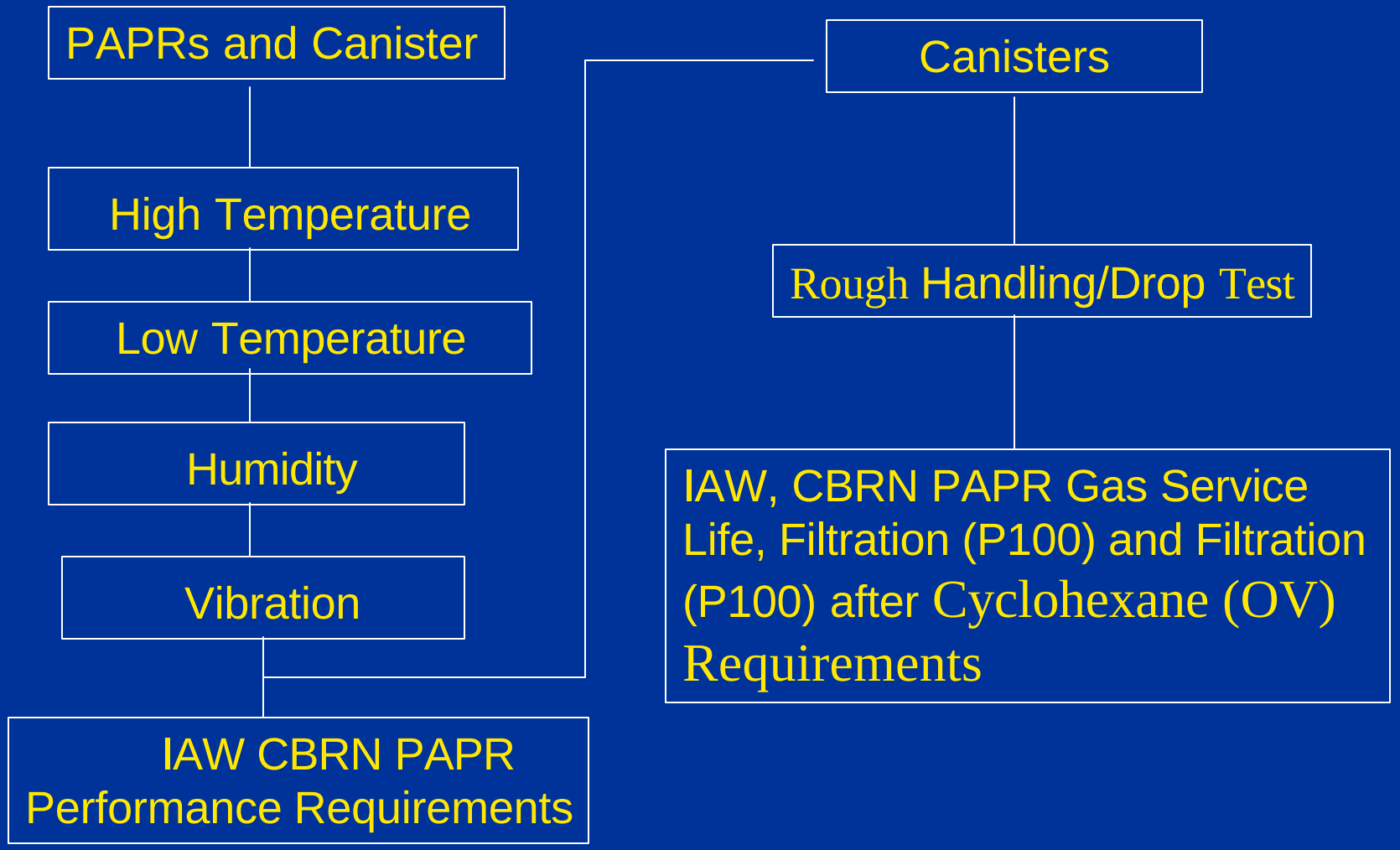
Low Temperature: Representative of minimum temperature in U.S. intermediate zones per Mil-Std-810F (Basic Cold); Duration is minimum 810F recommended exposure period.

Humidity: Represents natural temperature humidity profile in humid regions of U.S. per Mil-Std-810F; Duration is minimum 810F recommended exposure period.

Vibration: Simulates vehicle transport of total of 12,000 miles on U.S. roadways in a unrestrained configuration.

Rough Handling: Simulates drop or fall from vehicle or table-top.

Flow Diagram of Durability Test



Durability Test Matrix

Test	Test Method	Test Conditions	Duration	Pass/Fail Threshold
Hot Diurnal	Mil-Std-810F 501.4	(35 ^{0}C/ 95 ^{0}F) to (71 ^{0}C/ 160 ^{0}F), 24 Hour cycle	3 Weeks	Filters + PAPRs NIOSH CBRN PAPR requirements
Cold Constant	Mil-Std-810F 502.4	Basic Cold, -32 ^{0}C (-24 ^{0}F), Constant	3 Days	
Humidity	Mil-Std-810E 507.3	Realistic, Natural Cycle Humidity Profiles in the U.S.	5 Days "quick look" Mil-Std-810E Table 507.3-II	
Transportation Vibration	Mil-Std-810F 514.5	U. S. Roadway Vibration, Unrestrained	12 hours/axis, 3 Axes Total duration = 36 hours = 12,000 miles	

Drop Test: In Ready To Use Condition	Canisters Only	3 axes, 1 drop/filter per axis	Height of 3 feet	Gas Service Life, Filtration (P100) and Filtration After OV Gas Life